

Chromosome Number and Taxonomic Note on *Cardamine arakiana* Koidz. (Cruciferae)

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オオマルバノコンロンソウ（アブラナ科）の染色体数及び分類

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Chromosome number of *Cardamine arakiana* $2n=32$ is reported for the first time. The taxonomy and relationship of the species are discussed in the light of rhizome and embryo morphology.

Cardamine arakiana was described by Koidzumi (1936) based on the Yeichi Araki's collection from Oki, Nishinakasaji-mura, Kyoto Prefecture, Honshu, Japan. Ohwi (1953, 1965), Kitamura and Murata (1961), and Kitagawa (1982) treated the species in their floras. Murata (1979) reported the two new localities from Hyogo Prefecture (Kora, Hikami-cho) and Okayama Prefecture (Iwadani, Bitchu-cho), considering it to be rare. During our studies of *Cardamine* and its allied genera, we have made field observations at Kora, Hyogo Prefecture. A population of *C. arakiana* was found in the grassy clay silty forest floor in a natural vegetation. The population was restricted to an area around 1 ha. and was composed of approximately 50 scattered individuals.

The present paper aims to provide the chromosome number and to discuss its identity and taxonomy.

The chromosome number was counted in the root tips. The materials were obtained from the transplanted individuals at Tokyo and were pretreated in 2 mM 8-hydroxyquinoline for 4 hours; fixed for 2 hours in acetic ethanol (1:3) at 5°C; macerated in 1NHCl for 15 seconds at 60°C and squashed after staining for 30 minutes in 2% aceto-orcein. The voucher specimens (A. Rashid, H. Setoguchi and N. Kuroasaki, no. 910413) were deposited in TI.

Results and Discussion

Chromosome number. Somatic chromosome number was counted in 7 individuals and was

$2n=32$ (Fig. 1a). No different number was observed among the individuals. The chromosomes varied in length from 1.8 to 0.8 μm and the centromere position were not distinct. However, one pair of chromosomes were clearly distinguished bearing satellites. As in *Cardamine* majority of the species reported possess the basic number 8, *C. arakiana* is therefore, regarded as a tetraploid species.

The number of somatic chromosomes are constant with no variation in the investigated population, but shows a gradual decrease in length. Kurosawa (1981) reported the chromosome number in *C. yezoensis* ($2n=32$) and *C. torrentis* ($2n=56$) from Japan as none of them has been

shown to possess satellites but *C. arakiana* is very unique in presence of a pair of chromosomes with satellites which may be helpful in tracing the ancestral origin in further studies.

Morphology of rhizome. The number of flowering stems in an individual varies from 1 to 7, but usually it has three or four flowering stems growing from the rhizome. Rhizomes are tuberous, ovoid, 0.9–2.3 cm long, 0.5–1.5 cm wide, scaly, bearing 2–8 bulbils in the axils of radical and scaly leaves (Fig. 1b). The bulbil is crowded with scaly leaves forming a rossette like structure. Sometimes the scaly leaves also have axillary buds. Juvenile shoots grow from the apical buds or axillary buds and consist of thick basal portion

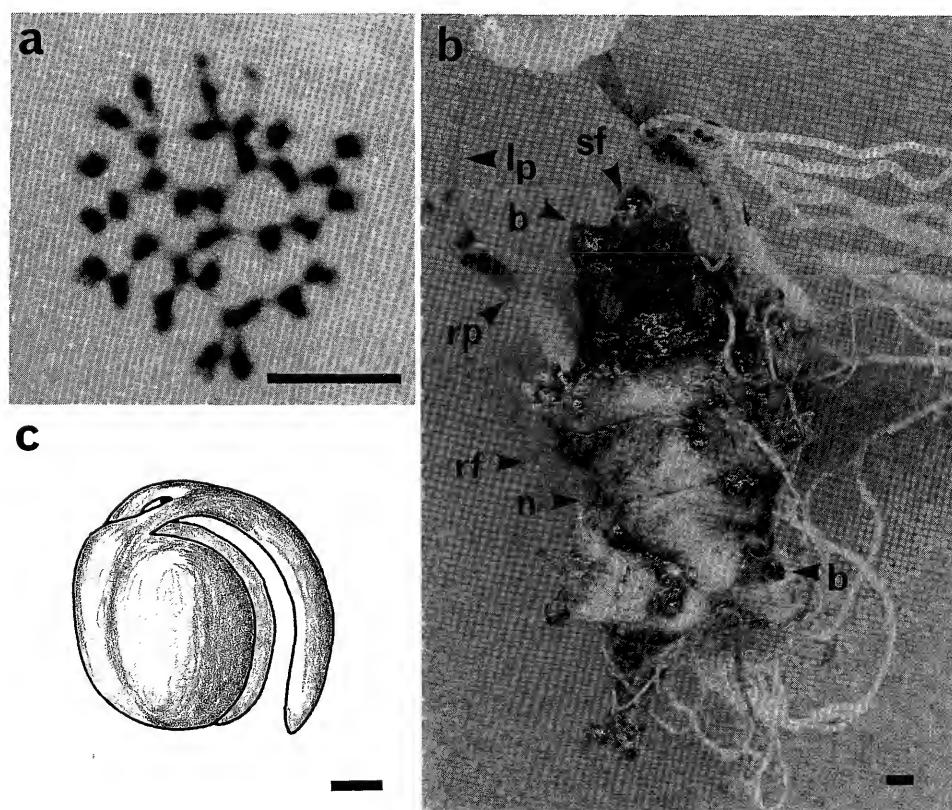


Fig. 1. a: Somatic chromosomes at metaphase in root tip cell. Bar: 5 μm . b: Rhizome with juvenile shoot. Bar: 1 mm. rf, former year's rhizome; st, former year's shoot; n, node; b, bulbil; rp, present year's rhizome; lp, present year's leaf. c: Pleurorhizal petiolate cotyledon in seed. Bar: 1 mm.

continuous to a 7 to 12 mm slender elongate, stem like upper portion with 3 to 9 simple leaves. The basal portion is considered to be a rhizome. Fibrous adventitious roots arise from rhizome and the axils of scaly and radical leaves. The upper portion is considered as flowering stem. The flowering stem bears simple leaves in the beginning stage but later the caudine leaves are impari-pinnately compound usually with three leaflets.

A part of the rhizome attached to the old rhizome remained slender as a rhizome stalk. The previous year's rhizome deplets after the establishment of the rooting system in the new plant. But in some cases the old rhizome still remains intact with the young shoot. The observations at bud initiating and fruiting phases lead us to the conclusion that the new shoot will grow at the expense of bulbous rhizome with establishment of the plant and then will initiate the elongation together with the enlargement of the rhizome as well as growth of the bulbils in the axils of radical and scaly leaves.

Cotyledons. The cotyledons in seeds are flat, oblong and apparently petiolate. The embryo type is considered as pleurorhizal i.e. the radicle extends along the edges of cotyledons and is situated along the hilum (Fig. 1c). The radicle is present longitudinally in the seed and makes a radicular ridge.

Taxonomic note

Ohwi (1965) and Kitagawa (1982) consider *C. anemonoides* as a close species of *C. arakiana* on the basis of short rhizome and trifoliately pinnate leaves and also allied to *C. tanakae* in leaf shape.

By having scaly rhizomes and pleurorhizal embryos with flat and petiolate cotyledons, *C. arakiana* is coincident with *C. anemonoides* in the section *Dentaria* in sense of Schulz (1903). *Cardamine anemonoides* greatly differs from *C.*

arakiana in possessing delicate small stolons arising from the rhizome, glabrous stem, absence of radical leaves, rhombic-lanceolate to linear lanceolate leaflets, and large flowers with petals 8–10 mm long. *Cardamine arakiana* lacks stolons, but possesses bulbils, hairy stem, radical leaves, reniform or ovate leaflets, and small flowers with petals 4–5 mm long. Therefore the two species are far removed from one another and can not be thought to be derived from a common ancestor.

However, *C. tanakae* shows the similarities in the morphology of juvenile shoot arising from the previous year's rhizome; petiolate cotyledons, hairy reniform leaves and thirty two number of chromosomes. *Cardamine arakiana* is peculiar in its tuberous, ovoid rhizome having bulbils, but *C. tanakae* has the previous year's rhizome which is comparatively slender, lacking bulbils, and new shoots growing directly from the new buds.

Cardamine anemonoides is distributed throughout SW Japan, from Kanto district westward, Shikoku and Kyushu while *C. arakiana* is restricted to three prefectures in Kinki and Chugoku districts in western Honshu.

Cardamine tanakae is represented throughout Japan except Hokkaido. Schulz (1903) classified *C. tanakae* in the section *Cardamine* (= *Eucardamine*) characterized rhizomes without scales and frequently sessile cotyledons. However, *C. tanakae* has rhizomes with deciduous scales and obviously petiolate cotyledons.

The characters such as tuberous, ovoid rhizome, radical leaves and pilose nature of the stem found in *C. arakiana* are common with the species of the section *Eutreptophyllum* Schulz (1903) distributed in Western North America.

Taxonomic treatment

Cardamine (? section Dentaria) arakiana Koidz.
in Acta Phytotax. Geobot. 5: 119 (1936) –
Honda, Nom. Pl. Jap. 116 (1939) – Ohwi, Fl.
Jap. 572 (1953); Engl. ed. 483 (1965); new ed. 671
(1965) – Kitamura and Murata, Col. Ill. Herb.
Pl. Jap. 2: 175 (1961) – Murata in Acta
Phytotax. Geobot. 30: 134 (1979) – Kitagawa in
Satake et al., Wild Flow. Jap. 2: 132 (1982).

Specimens examined. Japan. Pref. Kyoto: Oki,
Nishinakasaji-mura (Fukuchiyama-shi) (Y. Araki
13935 on April 19, 1936, KYO – lectotype, TI –
isolectotype), same loc. (Y. Araki 13935 on May
18, 1936, KYO – syntype, TI – isosyntype). Pref.
Hyogo: Kora, Hikami-cho, Hikami-gun (I.
Hosomi 5575 on March 3, 1963, KYO), same loc.
(Rashid, Setoguchi and Kurosaki 910413 on April
13, 1991, TI). Okayama Pref: Kawakami-gun,
Bitchu-cho, Iwayadani (I. Okubo s.n. on April 1,

1979, KYO).

References

(Other references are in the taxonomic treatment.)
Kurosawa S. 1981. Notes on chromosomes of spermatophytes (3). J. Jpn. Bot. 56: 245–251.
Schulz O. E. 1903. Monographie der Gattung *Cardamine*.
Bot. Jahrb. 32: 280–623.

要旨

オオマルバノコンロンソウは近畿、中国地方の
一部に分布が限定される狭分布種で、現在判明し
ている自生地は少ない。これまで染色体数をはじ
め、この植物の詳細な形態は知られていなかった
ので、報告した。染色体数は $2n=32$ であったが、
これはアブラナ科の多くの種が $X=8$ を基本数と
することを根拠に 8 を基本数と仮定すれば 4 倍体
とみなされる。本種はミツバコンロンソウに近縁
であると考えられるが、今後マルバコンロンソウ
との関係もさらに追求する必要がある。